



Spot Safety Project Development

Kelly Becker, PE
Regional Traffic Engineer
Capital Region

Spot Safety Program

- \$9.1 Million Per Year Statewide
- \$250,000 Maximum Per Project
- Projects selected for funding based on a statewide priority basis
- Projects on hold for funding reprioritized often
- Division and Region both submit candidate projects
- Division responsible for construction

Spot Safety Program

- Field Investigation & Engineering Analyses
- Determine most appropriate counter measures
- Obtain cost estimates (construction, utilities, right-of-way)
- Calculate Benefit-Cost ratio
- Division & Regional prioritization
- Safety Index Process – Determines statewide ranking
- Oversight Committee
- Board of Transportation approval & funding

Spot Safety Index

- Safety – B/C, HSIP, Correctable Crashes
- Department Goals
- Constructability & Delivery
- Responsiveness (Div. & Region Priorities)



Initial Project Development Steps

- Identification of Countermeasures
- Cost Estimate
- Determination of Crash Reduction Factors Used
- Benefit-Cost Ratio
- Determination to add to Spot Safety Hold List



Crash Reduction Factors Committee

- Established in 2001
- Provides consistency among Spot Safety and W-Projects with similar countermeasures
- Committee Members rotate off periodically



Crash Reduction Factors Committee

- Pate Butler, PE – Cape Fear RTE
- Scott Collier, PE – Blue Ridge RTSE
- Al Grandy – Sandhills RTE
- John Button, PE – Triad RTSE
- Shawn Troy, PE – TSU Safety
Evaluation Engineer
- Kelly Becker, PE – Capital RTE

CRF Reference # 1

North Carolina Project Development Crash Reduction Factor Information

Revised May 30, 2007

Countermeasure	Crash Pattern Affected -- Site Specification	Percent Reduction	Date -- Study -- Reference
1. Traffic Signals			
1.1 Install a Traffic Signal	Total Crashes	22	April 01 -- WPRFC Meeting Handout -- Reference 1, 2
	"OR"		
	Total Angle Crashes	65	April 01 -- WPRFC Meeting Handout -- Reference 13
	<u>3-leg Urban Intersection</u> (Injury includes fatality and injury crashes)		
	Total Injury Crashes	14	November 05 -- NCHRP Digest 299 -- Study 4
	"OR"		
	Total Right-Angle Injury Crashes	34	November 05 -- NCHRP Digest 299 -- Study 4
	Total Rear-End Injury Crashes	-50	November 05 -- NCHRP Digest 299 -- Study 4
	<u>4-leg Urban Intersection</u> (Injury includes fatality and injury crashes)		
	Total Injury Crashes	23	November 05 -- NCHRP Digest 299 -- Study 4
	"OR"		
	Total Right-Angle Injury Crashes	67	November 05 -- NCHRP Digest 299 -- Study 4
	Total Rear-End Injury Crashes	-38	November 05 -- NCHRP Digest 299 -- Study 4
1.2 Upgraded Traffic Signals	Total Crashes	22	April 01 -- WPRFC Meeting Handout -- Reference 1, 11
	"OR"		
	Total Fatal Crashes	38	April 01 -- WPRFC Meeting Handout -- Reference 1, 11
	Total Non-Fatal Injury Crashes	22	April 01 -- WPRFC Meeting Handout -- Reference 1, 11
1.3 Add Protected Left-Turn Phase	Total PDO Crashes	23	April 01 -- WPRFC Meeting Handout -- Reference 1, 11
	Total Crashes	25	April 01 -- WPRFC Meeting Handout -- Reference 8
	"OR"		
1.4 Add Protected Permissive Left-Turn Phase	Total Left-Turn Crashes	70	April 01 -- WPRFC Meeting Handout -- Reference 13
	Total Crashes	10	April 01 -- WPRFC Meeting Handout -- Reference 13
	"OR"		
1.5 Pretimed to Actuated	Total Left-Turn Crashes	40	April 01 -- WPRFC Meeting Handout -- Reference 13
	Total Crashes	20	April 01 -- WPRFC Meeting Handout -- Reference 8
1.6 Closed Loop Signal System	Total Crashes	15	April 01 -- WPRFC Meeting Handout -- Reference 8
1.7 Improve Signal Timing	Total Crashes	15	March 05 -- WPRFC Email -- ITE Safety Briefs
1.8 Upgrade 8" Signal Heads to 12" Signal Heads	Total Crashes	10	April 01 -- WPRFC Meeting Handout -- Reference 8
1.9 Long Vehicle Detection	Total Crashes	10*	September 06 -- WPRFC Email -- Subjective based on 6 B&A analyses
1.10 Signal Back Plates	Total Crashes	5*	September 06 -- WPRFC Email -- Subjective based on committee opinion
	"OR"		
	Total Right Angle Crashes	20	April 01 -- WPRFC Meeting Handout -- Reference 13



Safety Project Development Guide

Traffic Engineers need an organized tool to provide guidance in developing safety projects to correct common traffic safety problems. Highway safety research has provided excellent information on various crash patterns and possible treatments. The **Safety Evaluation Group** has developed this web page to disseminate research information into an easily accessible format for Traffic Engineers. The information contained herein is based on several sources and is periodically updated to reflect new data and ongoing research. The Countermeasures given should not be considered comprehensive. Accident Reduction Factors are given for only some of the countermeasures, based on available data. Absence of an Accident Reduction Factor does not imply a lesser effectiveness. Data sources can be located through the **NCDOT Research Library**.

The information contained herein is intended to be used a guide in helping Traffic Engineers develop safety projects. The information provided is not comprehensive and should not replace sound engineering judgment. Before proceeding, some data must be gathered first. After identifying a potential problem area, an accident study should be done to identify any potential crash patterns.

Countermeasure Development



FHWA's Highway Safety Engineering Studies Procedural Guide (1981)

W-Project Committee Reduction Factors (for use by NCDOT Regional Traffic Engineers)



(Adobe Reader Required)

Need Acrobat?



[Download it here.](#)

CRF Reference # 2

Desktop Reference for Crash Reduction Factors



Report No. FHWA-SA-07-015
U.S. Department of Transportation
Federal Highway Administration

September 2007

NEW

CRF Reference # 3

NCHRP REPORT 617

NATIONAL
COOPERATIVE
HIGHWAY
RESEARCH
PROGRAM

**Accident Modification Factors for
Traffic Engineering and
ITS Improvements**

Example – New Traffic Signal

Crash Pattern Affected	-- Site Specification	Percent Reduction
Total Crashes		22
"OR"		
Total Angle Crashes		65
<u>3-leg Urban Intersection</u>	(Injury includes fatality and injury crashes)	
Total Injury Crashes		14
"OR"		
Total Right-Angle Injury Crashes		34
Total Rear-End Injury Crashes		-50
<u>4-leg Urban Intersection</u>	(Injury includes fatality and injury crashes)	
Total Injury Crashes		23
"OR"		
Total Right-Angle Injury Crashes		67
Total Rear-End Injury Crashes		-38

Example – Right Turn Lane

Total Crashes	25
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"OR"

Total Right-Turn Crashes	50
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	Major Road Application	
<u>4-leg Rural and Urban Stop Sign controlled</u>	<u>1 Approach</u>	<u>Both Approaches</u>
Total Crashes	14	26

<u>4-leg Rural and Urban Signal controlled</u>
Total Crashes

4

8

Reduction Factors Methodology

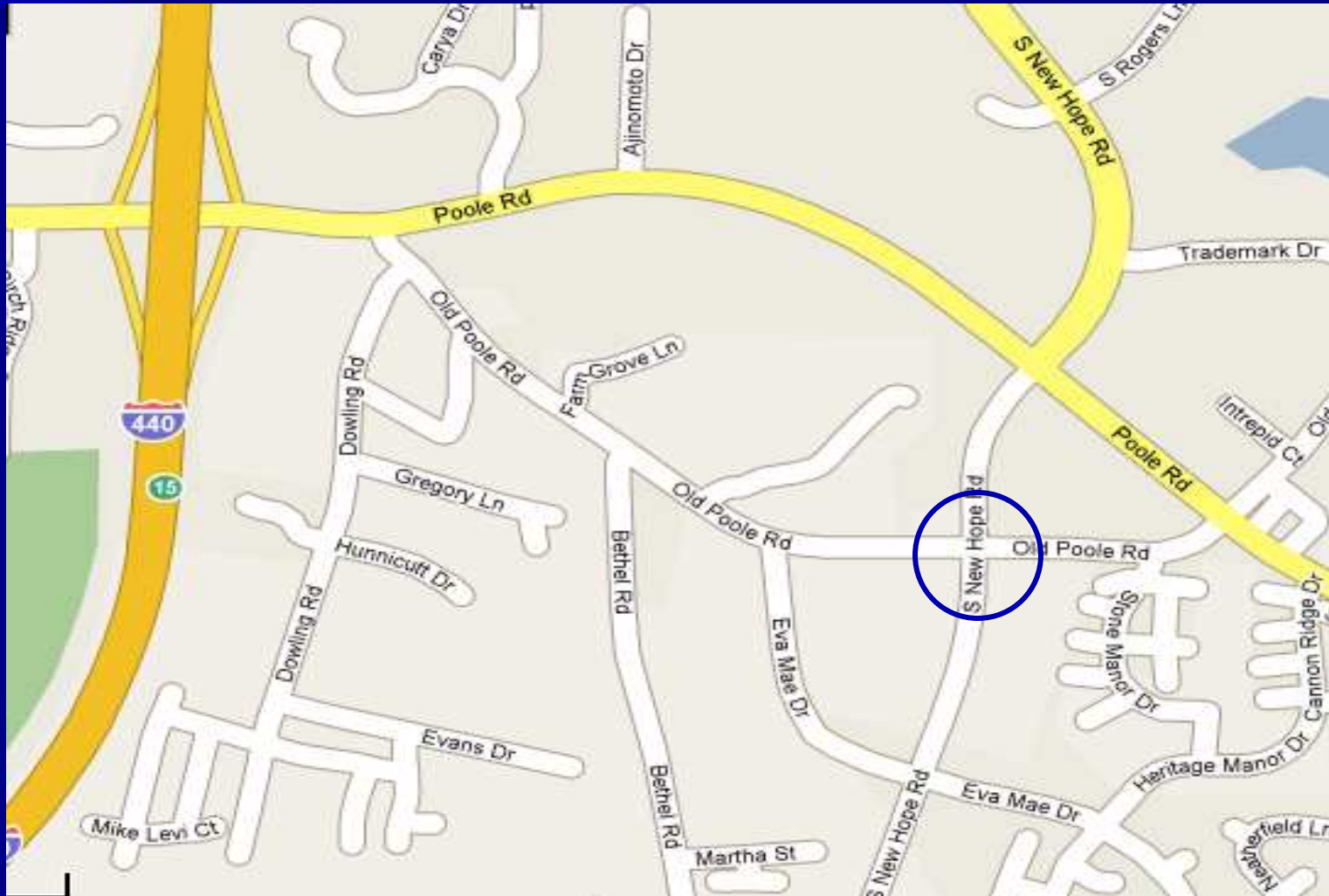
CRF's based on documented research

Use all crashes of specified crash type

Different than former methodology (process has evolved over time)

Spot Safety Project

SR 2036 (New Hope Rd.) at Old Poole Rd.
Raleigh, Wake Co.



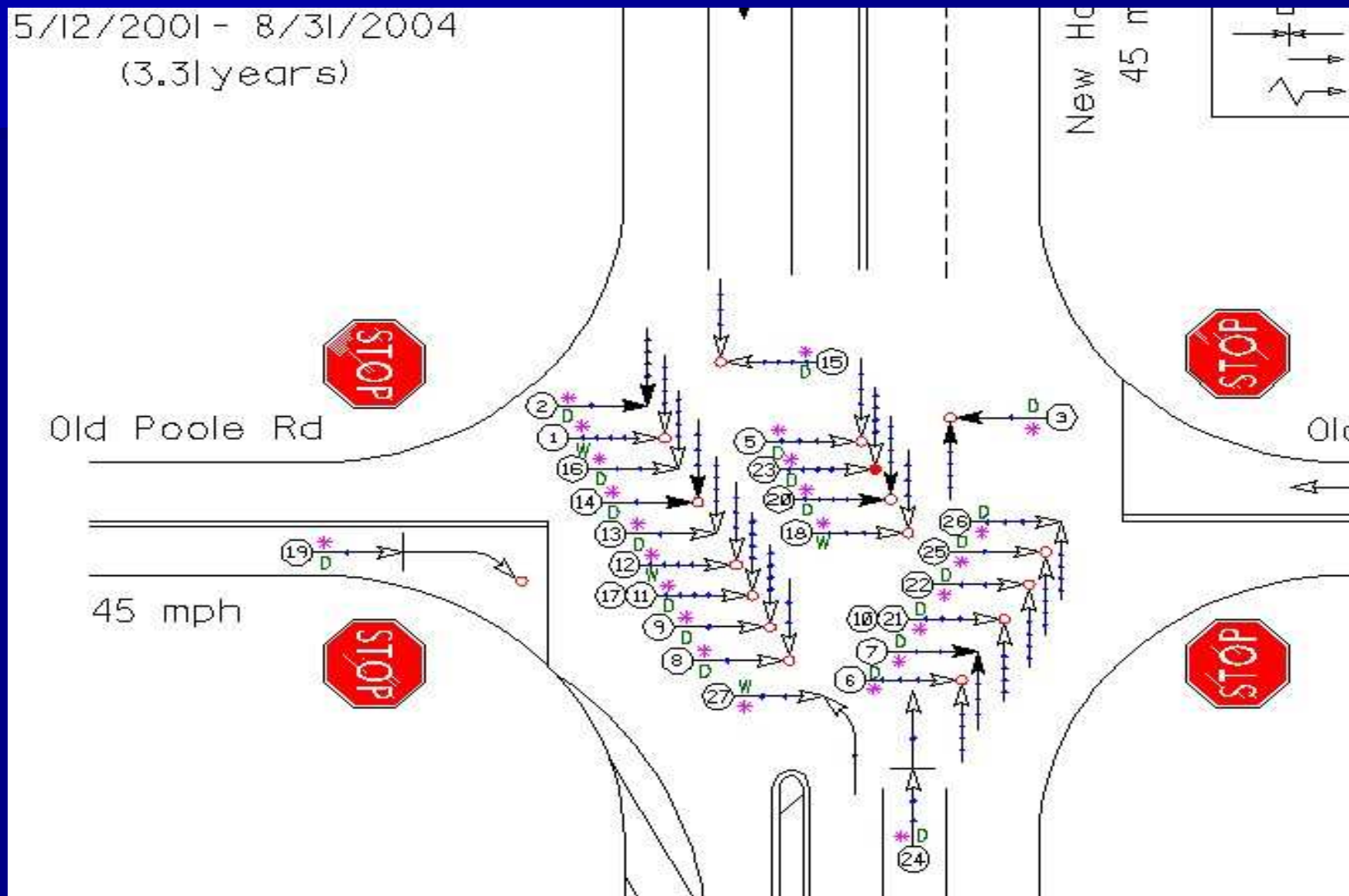


SR 2036 (New Hope Rd.) at Old Poole Rd.

- Fatal Crash Investigation in 2004
- EB vehicle ran STOP sign
- Review of Crash History
- 22 Angle Crashes in 3.31 years
- Ordered turning movement counts
- Determined appropriate countermeasure
- Calculated B/C

Collision Diagram - Before

5/12/2001 - 8/31/2004
(3.31 years)



Benefit-Cost Analysis

- Cost - Construction, Right of Way, Utilities
- Service Life of Countermeasure
- Annual Maintenance and Utility Costs
- Crash Reduction Factors
- Related Crash Types
- Number & Severity of Crashes (Typ. 5 yrs)
- Needs to be greater than 1 to qualify

BENEFIT-COST ANALYSIS

BY: K. L. Becker, PE

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LOCATION: SR 2036 (New Hope Rd.) at
Old Poole Rd. in Raleigh, Wake Co.DATE: 5/3/2005
FILE NO.: 05-05-203

DETAILED COST: TYPE IMPROVEMENT - Traffic Signal

ITEMS	LABOR	MATERIAL	EQUIP	TOTAL	SERVICE	CRF	ANNUAL COST
Construction	\$0	\$0	\$0	\$79,000	10	0.143	\$11,773
Right-of-Way	\$0	\$0	\$0	\$1,000	50	0.082	\$82

TOTALS	\$0	\$0	\$0	\$80,000	10	0.148	\$11,855
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ESTIMATED INCREASE IN ANNUAL MAINT. COST =	\$2,000
ESTIMATED INCREASE IN ANNUAL UTILITY COST =	\$900

TOTAL ANNUAL COST=	\$14,755
TOTAL COST OF PROJECT=	\$80,000

COMPREHENSIVE COST REDUCTION

ESTIMATED NUMBER OF ANNUAL ACCIDENT DECREASES

PATTERN	%	YEARS	K & A CRASHES	FATAL CRASHES PER YR	B & C CRASHES	INJURY CRASHES PER YR	PDO CRASHES	PDO CRASHES PER YR	TOTAL DECREASES	ANNUAL BENEFITS
Angle	65	3.31	1	0.20	15	2.95	6	1.18	4.32	\$885,375
Left Tra-Diff Rd	65	3.31	0	0.00	0	0.00	0	0.00	0.00	\$0
Rearend	-10	3.31	0	0.00	1	-0.03	1	-0.03	-0.06	(\$2,088)
TOTALS			1	0.20	16	2.92	7	1.15	4.26	\$883,287

K&A INJURIES PER YEAR REDUCED *	\$1,300,000	=	\$255,287
B&C INJURIES PER YEAR REDUCED *	\$40,000	=	\$116,616
PDO'S PER YEAR REDUCED *	\$4,300	=	\$4,337
TOTAL ANNUAL BENEFITS		=	\$376,840

AVERAGE ANNUAL BENEFITS	X	ADT FACTOR	ANNUAL BENEFITS
\$376,840	X	1.279	= \$481,961
NET AVG. ANNUAL BENEFITS = AVG. ANNUAL BENEFITS - TOTAL ANNUAL COST			= \$467,206
BENEFIT-COST RATIO = AVG ANNUAL BENEFITS/TOTAL ANNUAL COST			= 32.66

SR 2036 (New Hope Rd.) at Old Poole Rd.

- 22 Angle Crashes in 3.31 years
- CRF for New Traffic Signal
- 65% Reduction in Angle Crashes
- 10% Increase in Rearend Crashes
- $B/C = 32.66$

New Traffic Signal

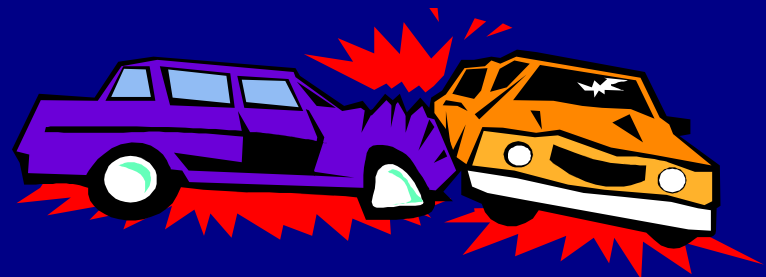
Crash Pattern Affected	-- Site Specification	Percent Reduction
Total Crashes		22
"OR"		
Total Angle Crashes		65
<u>3-leg Urban Intersection</u>	(Injury includes fatality and injury crashes)	
Total Injury Crashes		14
"OR"		
Total Right-Angle Injury Crashes		34
Total Rear-End Injury Crashes		-50
<u>4-leg Urban Intersection</u>	(Injury includes fatality and injury crashes)	
Total Injury Crashes		23
"OR"		
Total Right-Angle Injury Crashes		67
Total Rear-End Injury Crashes		-38

Supporting Data for B/C Traffic Signal

- Cost = \$80,000
- Service Life 10 years
- Annual Maintenance Increase \$2,000
- Annual Utility Increase \$900

Current Crash Costs Used Based on 2006 Data

- K & A Injuries Per Year Reduced
\$1,500,000
- B & C Injuries Per Year Reduced
\$43,000
- PDO's Per Year Reduced
\$4,700



If Analyzed Today

- Need to use data for 4-leg Urban Intersection

4-leg Urban Intersection (Injury includes fatality and injury crashes)

Total Injury Crashes	23
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"OR"

Total Right-Angle Injury Crashes	67
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Total Rear-End Injury Crashes	-38
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If Analyzed Today

- Total Injury Crashes 23% Reduction

$$B/C = 13.18$$

OR

- Total Right Angle Injury Crashes 67% Reduction & Total Rearend Injury Crashes 38% Increase

$$B/C = 37.21$$

SR 2036 (New Hope Rd.) at Old Poole Rd.

Interim Measures

- Dual mounted Stop signs & Stop Ahead warning signs
- Adjusted locations of Stop Ahead signs
- Solar-powered flasher on EB Stop sign

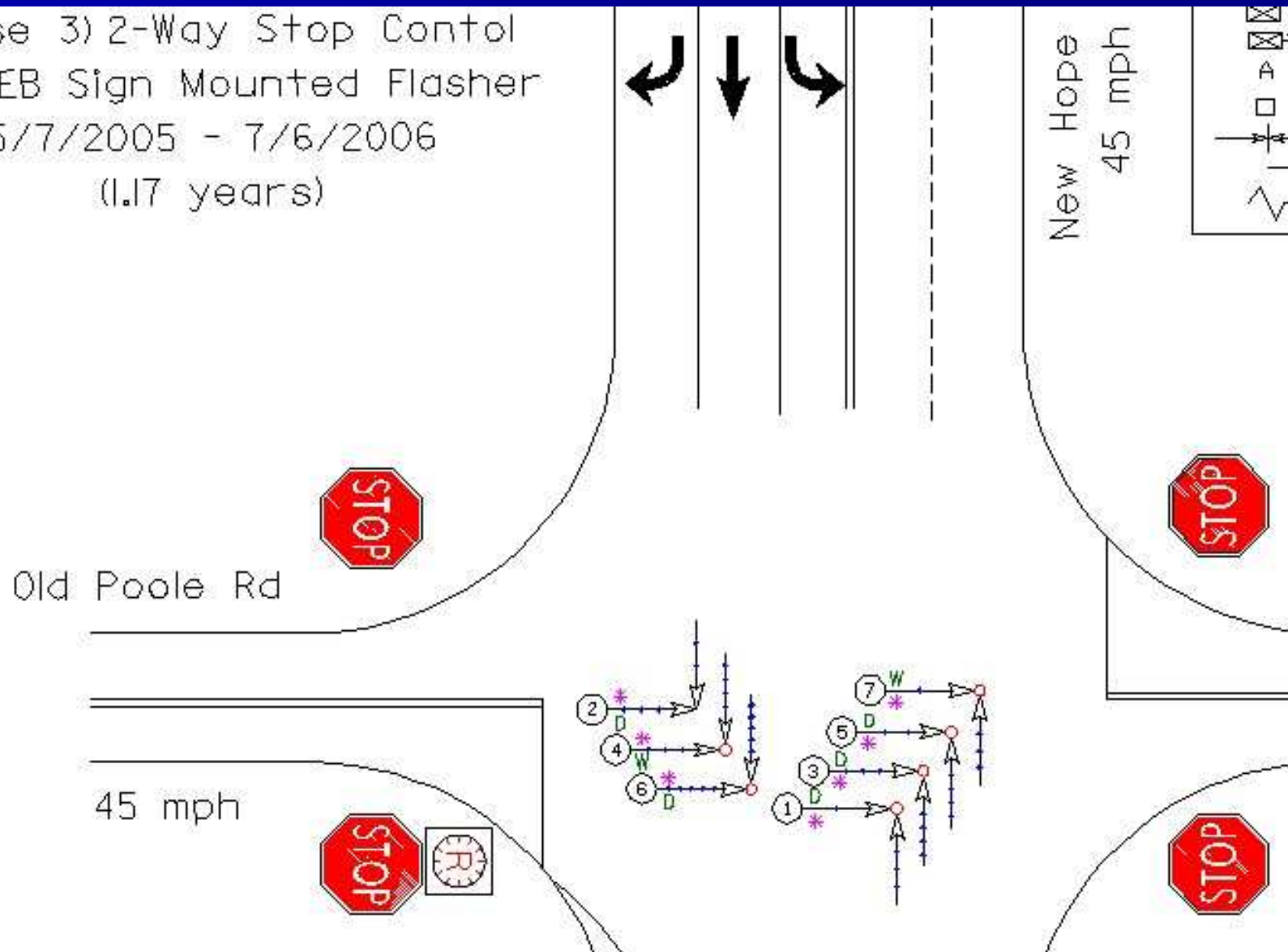


Solar Powered Flasher EB



After Solar Flasher Installed

Phase 3) 2-Way Stop Control
With EB Sign Mounted Flasher
5/7/2005 - 7/6/2006
(1.17 years)

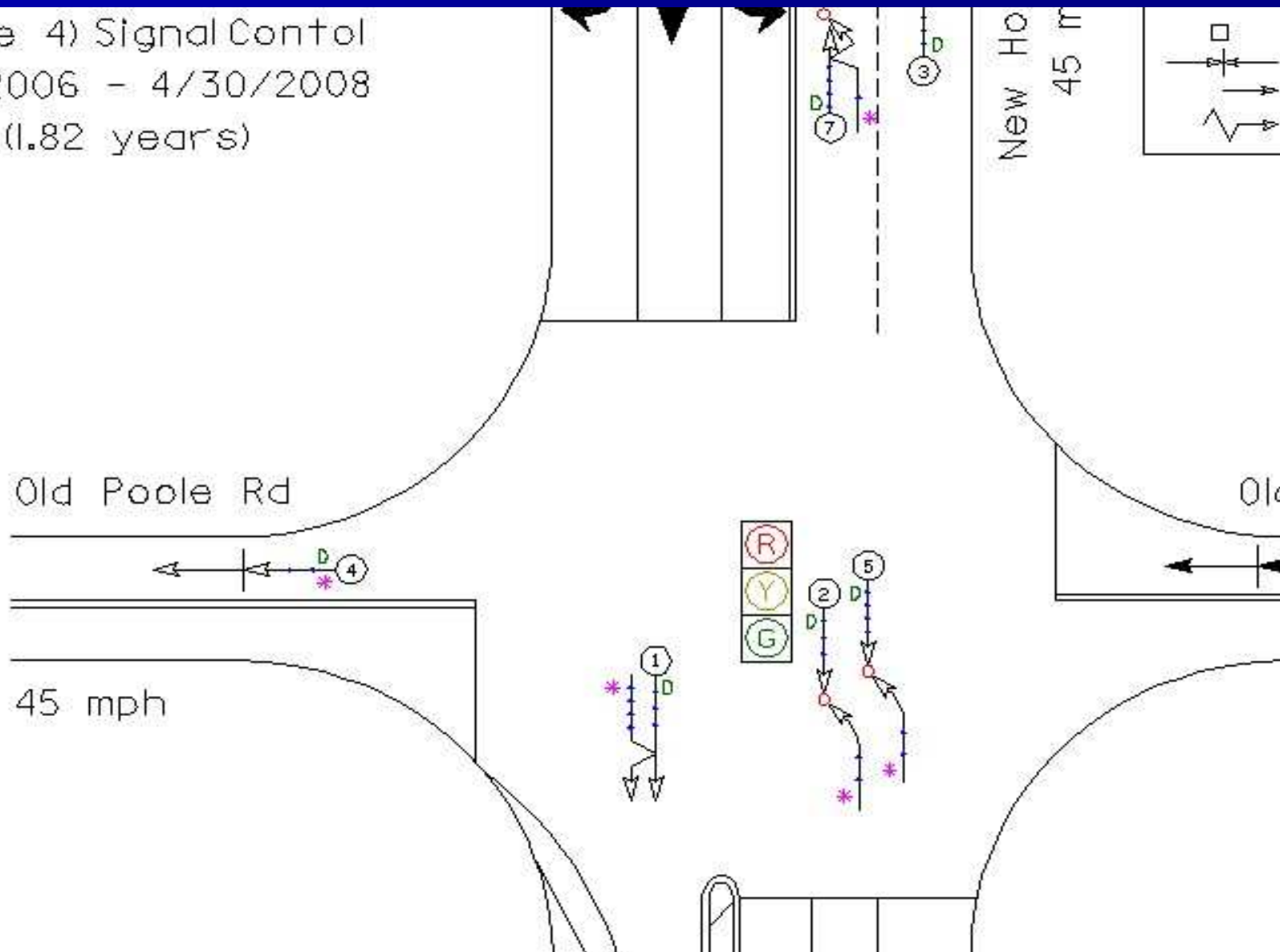


Traffic Signal

- Installed in July 2006
- Interconnected with fiber to adjacent signal at New Hope Rd. and Poole Rd.

After Signal Installed

Phase 4) Signal Control
7/7/2006 - 4/30/2008
(1.82 years)



Before and After

<i>Before and After Signal Installation</i>					
Before - 2-Way Stop Operation: 5/12/2001 - 8/31/2004					
After - Signal Control: 8/1/2006-4/30/2008					
	Before: 2-Way Stop		After: Signalized		Percent Reduction (-)/
	3.31 Years	Per Year	1.75 Years	Per Year	Percent Increase (+)
Total Crashes	27	8.2	7	4	-51.0%
Total Severity Index	8.74	---	4.17	---	-52.3%
Target Crashes -					
Frontal Impact	24	7.3	2	1.1	-84.2%
Target Severity Index-					
Frontal Impact	9.40	---	8.40	---	-10.6%
Volume	8600	---	12300	---	43.0%

Questions?

